

What is claimed is:

1. A mixer circuit, comprising:

an oscillator;

a first mixer of which high-frequency signal is supplied to one input, and output signal of the oscillator is supplied to the other input;

an output terminal to which output from the first mixer is supplied;

a second mixer of which the high-frequency signal is supplied to one input thereof;

a first oscillator phase shifter which is connected between the other input of the second mixer and the output of the oscillator and serves to shift the phase of output signal of the oscillator by $-\pi/3$ radian as against the phase of the other input of the first mixer;

a first intermediate frequency phase shifter which is connected between the output of the second mixer and the output terminal and serves to shift the phase of output of the second mixer by $-5\pi/3$ radian;

a third mixer of which the high-frequency signal is supplied to one input thereof;

a second oscillator phase shifter which is connected between the other input of the third mixer and the output of the oscillator and serves to shift the phase of output signal of the oscillator by $-2\pi/3$ radian as against the phase of the

other input of the first mixer; and

a second intermediate frequency phase shifter which is connected between the output of the third mixer and the output terminal and serves to shift the phase of output of the third mixer by $-4\pi/3$ radian,

wherein each of the other input of the first mixer, the other input of the second mixer, and the other input of the third mixer is provided with a limiter circuit.

2. The mixer circuit of claim 1, further comprising a filter which is inserted in the output of the oscillator and allows the fundamental output component of the oscillator to pass.

3. The mixer circuit of claim 1,

wherein the first oscillator phase shifter and the second oscillator phase shifter are based on a flip-flop system; and

wherein the first intermediate frequency phase shifter and the second intermediate frequency phase shifter are based on a poly-phase filter system.

4. The mixer circuit of claim 1, wherein the first oscillator phase shifter, the second oscillator phase shifter, the first intermediate frequency phase shifter, and the second intermediate frequency phase shifter are based on a poly-phase

filter system.

5. The mixer circuit of claim 1, wherein the first oscillator phase shifter, the second oscillator phase shifter, the first intermediate frequency phase shifter, and the second intermediate frequency phase shifter are based on a flip-flop system.

6. A mixer circuit, comprising:

an oscillator;

M (M is a natural number 3 or over) pieces mixers of which high-frequency signal is supplied to one respective inputs, and output signal of the oscillator is supplied to the other respective inputs;

an output terminal to which the outputs of the respective mixers are supplied;

K-th (K is a natural number ranging from 1 to M with 1 added each) oscillator phase shifter which is connected between the other input of K-th (K is a natural number ranging from 1 to M with 1 added each) mixer out of the M pieces of the mixers and the oscillator and serves to shift the output signal of the oscillator by $-K\pi/M$ radian; and

K-th (K is a natural number ranging from 1 to M with 1 added each) intermediate frequency phase shifter which is connected between the output of the K-th mixer and the output terminal

and serves to shift the output of the K-th mixer by $-2\pi + K \pi/M$ radian,

wherein each of the other inputs of the respective mixers is provided with a limiter circuit.

7. The mixer circuit of claim 6, further comprising a filter which is inserted in the output of the oscillator and allows the fundamental output component of the oscillator to pass.

8. The mixer circuit of claim 6, wherein the other input of the M-th mixer is directly connected to the output of the oscillator, and the output of the M-th mixer is directly connected to the output terminal.

9. A mixer circuit, comprising:

an oscillator;

a first mixer of which high-frequency signal is supplied to one input, and output signal of the oscillator is supplied to the other input;

an output terminal to which output from the first mixer is supplied;

a second mixer of which the high-frequency signal is supplied to one input thereof;

a first oscillator phase shifter which is connected between

the other input of the second mixer and the output of the oscillator and serves to shift the phase of output signal of the oscillator by $-\pi/3$ radian as against the phase of the other input of the first mixer;

a first intermediate frequency phase shifter which is connected between the output of the second mixer and the output terminal and serves to shift the phase of output of the second mixer by $-5\pi/3$ radian;

a third mixer of which the high-frequency signal is supplied to one input thereof;

a second oscillator phase shifter which is connected between the other input of the third mixer and the output signal of the oscillator and serves to shift the phase of output signal of the oscillator by $-2\pi/3$ radian as against the phase of the other input of the first mixer; and

a second intermediate frequency phase shifter which is connected between the output of the third mixer and the output terminal and serves to shift the phase of output of the third mixer by $-4\pi/3$ radian,

wherein there are provided

a first mixer circuit of which each of the other input of the first mixer, the other input of the second mixer, and the other input of the third mixer is provided with a limiter circuit;

a second mixer circuit which forms an image rejection mixer,

using the first mixer and the oscillator; and

a switching means which is capable of switching the first mixer circuit and the second mixer circuit by signals from a switching control circuit.

10. A mixer circuit, comprising:

a third mixer circuit comprising:

an oscillator;

M (M is a natural number 3 or over) pieces of mixers of which high-frequency signal is supplied to one respective inputs, and output signal of the oscillator is supplied to the other respective inputs;

an output terminal to which the outputs of the respective mixers are supplied;

K-th (K is a natural number ranging from 1 to M with 1 added each) oscillator phase shifter which is connected between the other input of K-th (K is a natural number ranging from 1 to M with 1 added each) mixer out of the M pieces of the mixers and the oscillator and serves to shift the output signal of the oscillator by $-K\pi/M$ radian; and

K-th (K is a natural number ranging from 1 to M with 1 added each) intermediate frequency phase shifter which is connected between the output of the K-th mixer and the output terminal and serves to shift the output of the K-th mixer by $-2\pi + K\pi/M$ radian,

wherein each of the other inputs of the respective mixers is provided with a limiter circuit;

wherein the other input of the M-th mixer is directly connected to the output of the oscillator, and the output of the M-th mixer is directly connected to the output terminal; and

wherein the value of M is 4;

an image rejection mixer, using parts in the third mixer circuit; and

a switching means which is capable of switching the third mixer circuit and the image rejection mixer by signals from a switching control circuit.

11. A mixer circuit, comprising:

a fourth mixer circuit formed of an image rejection mixer;

a fifth mixer circuit formed of an image rejection mixer;

an oscillator commonly used by at least the fourth mixer circuit and the fifth mixer circuit;

an oscillator phase shifter which supplies signals, phase-shifted by $-\pi/3$ radian as against signals inputted from the oscillator to the fourth mixer circuit, to the fifth mixer circuit;

a sixth mixer circuit with the fourth mixer circuit and the fifth mixer circuit connected in parallel fashion; and

a switching means which is capable of switching the fourth

mixer circuit and the sixth mixer circuit by signals from a switching control circuit.

12. The mixer circuit of claim 6, wherein at least the mixer and the oscillator phase shifter are integrated in same package.

13. The mixer circuit of claim 6, wherein at least the mixer, the oscillator phase shifter, and the intermediate frequency phase shifter are integrated in same package.

14. A high-frequency signal receiver, comprising:
a pre-filter to which high frequency signal is supplied;
a mixer circuit comprising:

an oscillator;

a first mixer of which output of the pre-filter is supplied to one input, and output signal of the oscillator is supplied to the other input;

an output terminal to which output from the first mixer is supplied;

a second mixer of which output of the pre-filter is supplied to one input thereof;

a first oscillator phase shifter which is connected between the other input of the second mixer and the output of the oscillator and serves to shift the phase of output signal of the oscillator by $-\pi/3$ radian as against the phase of the

other input of the first mixer;

a first intermediate frequency phase shifter which is connected between the output of the second mixer and the output terminal and serves to shift the phase of output of the second mixer by $-5\pi/3$ radian;

a third mixer of which output of the pre-filter is supplied to one input thereof;

a second oscillator phase shifter which is connected between the other input of the third mixer and the output signal of the oscillator and serves to shift the phase of output signal of the oscillator by $-2\pi/3$ radian as against the phase of the other input of the first mixer; and

a second intermediate frequency phase shifter which is connected between the output of the third mixer and the output terminal and serves to shift the phase of output of the third mixer by $-4\pi/3$ radian,

wherein there are provided a mixer circuit in which each of the other input of the first mixer, the other input of the second mixer, and the other input of the third mixer is provided with a limiter circuit; and

an output terminal to which output signal of the mixer circuit is supplied,

wherein the pre-filter is relieved in attenuation characteristics at frequencies that become image interfering signals and interfering signals being at a lower side or upper

side apart by intermediate frequency as against a frequency three times higher than the fundamental frequency of the oscillator in the mixer circuit.

15. A high-frequency signal receiver, comprising:
a pre-filter to which high-frequency signal is supplied;
a mixer circuit comprising:

an oscillator;

M (M is a natural number 3 or over) pieces of mixers of which the output of the pre-filter is supplied to one respective inputs, and the output signal of the oscillator is supplied to the other respective inputs;

an output terminal to which the outputs of the respective mixers are supplied;

K-th (K is a natural number ranging from 1 to M with 1 added each) oscillator phase shifter which is connected between the other input of K-th (K is a natural number ranging from 1 to M with 1 added each) mixer out of the M pieces of the mixers and the oscillator and serves to shift the output signal of the oscillator by $-K\pi/M$ radian; and

K-th (K is a natural number ranging from 1 to M with 1 added each) intermediate frequency phase shifter which is connected between the output of the K-th mixer and the output terminal and serves to shift the output of the K-th mixer by $-2\pi + K\pi/M$ radian,

wherein there are provided the mixer circuit in which each of the other inputs of the respective mixers is provided with a limiter circuit; and

an output terminal to which output signal of the mixer circuit is supplied,

wherein the pre-filter is relieved in attenuation characteristics at frequencies that become image interfering signals and interfering signals being at a lower side or upper side apart by intermediate frequency as against a frequency three times higher than the fundamental frequency of the oscillator.

16. A high-frequency signal receiver, comprising:

a pre-filter to which high frequency signal is supplied;

a mixer circuit comprising:

a first mixer circuit comprising:

an oscillator;

a first mixer of which output of the pre-filter is supplied to one input, and output signal of the oscillator is supplied to the other input;

an output terminal to which output from the first mixer is supplied;

a second mixer of which output of the pre-filter is supplied to one input thereof;

a first oscillator phase shifter which is

connected between the other input of the second mixer and the output of the oscillator and serves to shift the phase of output signal of the oscillator by $-\pi/3$ radian as against the phase of the other input of the first mixer;

a first intermediate frequency phase shifter which is connected between the output of the second mixer and the output terminal and serves to shift the phase of output of the second mixer by $-5\pi/3$ radian;

a third mixer of which output of the pre-filter is supplied to one input thereof;

a second oscillator phase shifter which is connected between the other input of the third mixer and the output signal of the oscillator and serves to shift the phase of output signal of the oscillator by $-2\pi/3$ radian as against the phase of the other input of the first mixer; and

a second intermediate frequency phase shifter which is connected between the output of the third mixer and the output terminal and serves to shift the phase of output of the third mixer by $-4\pi/3$ radian,

wherein each of the other input of the first mixer, the other input of the second mixer, and the other input of the third mixer is provided with a limiter circuit;

a second mixer circuit which forms an image rejection mixer, using the first mixer and the oscillator; and

a switching means which is capable of switching the

first mixer circuit and the second mixer circuit by signals from a switching control circuit;

a demodulation circuit to which output signal from the mixer circuit is supplied;

an output terminal to which output signal from the demodulation circuit is supplied;

a detection circuit which is supplied with output signal from the demodulation circuit and detects signal quality of the high-frequency signal; and

a switching control circuit which is inserted between the output of the detection circuit and a switching means in the mixer circuit and serves to operate the switching means in accordance with output of the detection circuit.

17. A high-frequency signal receiver, comprising:

a pre-filter to which high-frequency signal is inputted;

a mixer circuit comprising:

a third mixer circuit comprising:

an oscillator;

M (M is a natural number 3 or over) pieces of mixers of which output of the pre-filter is supplied to one respective inputs, and output signal of the oscillator is supplied to the other respective inputs;

an output terminal to which outputs of the respective mixers are supplied;

K-th (K is a natural number ranging from 1 to M with 1 added each) oscillator phase shifter which is connected between the other input of K-th (K is a natural number ranging from 1 to M with 1 added each) mixer out of the M pieces of mixers and the oscillator and serves to shift the output signal of the oscillator by $-K\pi/M$ radian; and

K-th (K is a natural number ranging from 1 to M with 1 added each) intermediate frequency phase shifter which is connected between the output of the K-th mixer and the output terminal and serves to shift the output of the K-th mixer by $-2\pi + K\pi/M$ radian,

wherein each of the other inputs of the respective mixers is provided with a limiter circuit;

wherein the other input of the M-th mixer is directly connected to the output of the oscillator, and the output of the M-th mixer is directly connected to the output terminal; and

wherein the value of M is 4;

an image rejection mixer using parts in the third mixer circuit; and

a switching means which is capable of switching the third mixer circuit and the image rejection mixer by signals from a switching control circuit;

a demodulation circuit to which output signal from the mixer circuit is inputted;

an output terminal to which output signal of the demodulation circuit is supplied;

a detection circuit which is supplied with output signal from the demodulation circuit and detects signal quality of the high-frequency signal; and

a switching control circuit which is inserted between the output of the detection circuit and a switching means in the mixer circuit and serves to operate the switching means in accordance with output of the detection circuit.

18. A high-frequency signal receiver, comprising:

a pre-filter to which high-frequency signal is inputted;

a mixer circuit comprising:

a fourth mixer circuit formed of an image rejection mixer;

a fifth mixer circuit formed of an image rejection mixer;

an oscillator shared by at least the fourth mixer circuit and the fifth mixer circuit;

an oscillator phase shifter which serves to supply signals, phase-shifted by $-\pi/3$ radian each with respect to signals inputted from the oscillator to the fourth mixer circuit, to the fifth mixer circuit;

a sixth mixer circuit formed with the fourth mixer

circuit and the fifth mixer circuit connected in parallel fashion; and

a switching means capable of switching the fourth mixer circuit and the sixth mixer circuit by signals from a switching control circuit,

wherein output signal of the pre-filter is inputted to the mixer circuit;

a demodulation circuit to which output signal from the mixer circuit is inputted;

an output terminal to which output signal from the demodulation circuit is supplied;

a detection circuit which is supplied with output signal from the demodulation circuit and detects signal quality of the high-frequency signal; and

a switching control circuit which is inserted between the output of the detection circuit and a switching means in the mixer circuit and serves to operate the switching means in accordance with output of the detection circuit.